

ROCK DRILL MOUNTINGS, STEELS, HOSE AND ACCESSORIES

INGERSOLL-RAND COMPANY

11 BROADWAY, NEW YORK

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THE rock drill as usually sold consists of the drill itself, with guide shell and feed screw, throttle, oiler and wrenches. But it does not include any mounting, or the necessary hose and steels. The various types of Ingersoll-Rand drills are described and listed in separate pamphlets. This pamphlet presents the standard line of Ingersoll-Rand drill mountings, air and steam hose, drill steels, and the other accessories usually entering into a complete rock drilling equipment.

While the efficiency and capacity of a rock drill plant depend primarily upon the drill itself, yet the quality of the accessories used has also an important bearing upon the performance of the outfit, the rate of progress, and the operating and up-keep cost. The severe service coming upon the drill itself is felt all along the line throughout the drill equipment; and it is therefore important that the drill accessories shall be well designed, well built and of a character to stand up under the most severe duty.

The line of Ingersoll-Rand rock drill equipment described and listed in this pamphlet has been created with this understanding; and it is fully comparable, in the essential qualities of satisfaction, with the Company's line of standard drills. It is a great mistake to expect good results from a high-class drill handicapped with a poor equipment. The Company's effort, therefore, has been to produce a consistent line of drills, mountings and accessories, of uniform superiority, and representing the very best value.

Rock Drill Mountings

The function of the mounting is to furnish a support to the drill which will be sufficiently rigid to maintain alignment of the steel with the hole. At the same time, it must be readily moved from hole to hole and must have a flexibility adapting it to all conditions of set-up.



Mounted on a Tripod

Rock drill practice has evolved four standard styles of mounting; the Tripod, for



Mounted on a Column

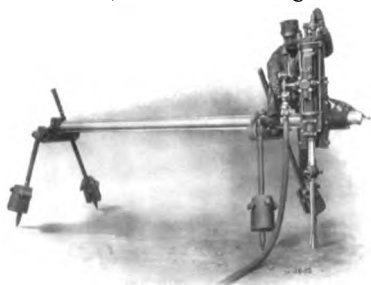
open-cut work and to a limited extent for shaft sinking; the Column, for tunneling and



Mounted on a Gadder

shaft sinking; the Quarry Bar, for quarry work and some classes of contract excavation; and the Gadder, a device for special quarry duty.

The Company's several types of these mountings are illustrated and described in the next few pages.

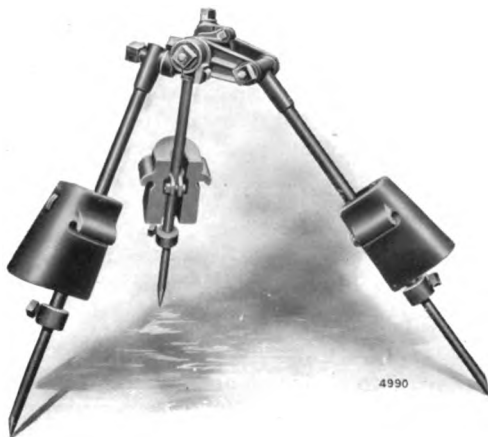


Mounted on a Quarry Bar

The "Sergeant 27" Tripod

The "27" Tripod is now the standard for all Ingersoll types of Ingersoll-Rand rock drills. It is an improvement upon the Sergeant "Universal" tripod, all the valuable features of which it retains. But it is heavier and stronger than the former type. All joints have cone surfaces, securing a powerful wedge effect under pressure of the adjusting bolts. The legs are telescopic and the weights adjustable.

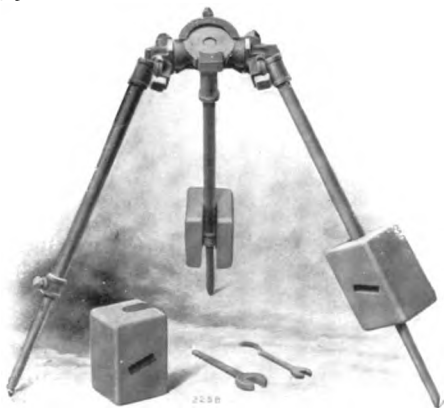
The new "27" Tripod is regularly furnished with the "Sergeant" saddle for the modern drill types. But on special order it will be equipped with the "Ingersoll" saddle fitting the old "Eclipse" drill, or with a "Lewis Hole" saddle.



A Sergeant Tripod Complete

The "Rand Adjustable" Tripod

The "Rand Adjustable" Tripod is the standard for the Rand types of Ingersoll-Rand rock drills—"Little Giant" and "Slugger."



The "Rand Adjustable" Tripod

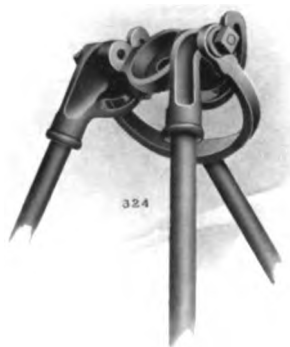
The shell cones on Ingersoll and Rand drill types differ slightly so that they are not interchangeable with either type of tripod. The Rand tripod has every desirable feature and affords a mounting of great strength and solidity, together with a wide range of adjustability.

The "Rand" saddle is standard with this tripod but a "Lewis Hole"

saddle for broaching will be furnished on order.

The "Quadrant" Tripod

Heavy, open-cut rock excavation, and other work calling for large, deep holes requiring the heaviest drills, demand a mounting of unusual strength; and since such holes are almost always vertical, or nearly so, no great range of adjustability is necessary in the mounting. The "Quadrant" Tripod is intended for such work. Its special feature is that the heavy drill need not be moved or tipped in changing steels, the quadrant dropping the machine back far enough to clear the hole.



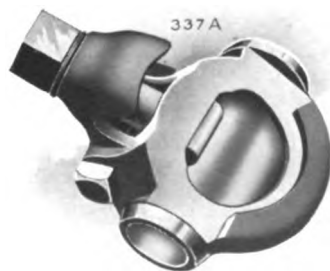
A "Quadrant" Tripod

The "Ingersoll" Tripod

This is an old type of mounting carried only to meet the demands of old customers who prefer it, to keep their equipment uniform. While without the wide adjustability of the "27" Tripod, it affords satisfactory service in quarry or open-cut work where vertical or slightly inclined down holes predominate. It is furnished only with the "Ingersoll" saddle, for use with the "Eclipse" drill.

The "Sergeant" Saddle

The "Sergeant" Reversed Cone Saddle fits the "Sergeant," "Arc Valve" and "New Ingersoll" types of Ingersoll-Rand drills. It is extremely simple and very powerful. The drill can be released by simply slacking off the T-bolt. When cleaning holes or changing steels, the drill can be swung clear without losing alignment. The weight of the drill, and all stresses in drilling are borne by the rim of the saddle instead of by the T-bolt and jaw.



The "Sergeant" Saddle

The "Rand" Saddle

This also is a reversed cone saddle, but the angle of the cone fits the cone of the Rand types of Ingersoll-Rand drills. In general design, in its massive construction, in its powerful grip and in ease of manipulation, it is very similar to the "Sergeant" saddle. But in some minor details of construction it differs from the latter. It takes the standard "Little Giant" and "Slugger" drills.



The "Rand" Saddle

The "Lewis Hole" Saddle

This is a special device furnished where there are several holes to be drilled in line close together, but where the number does not justify using a quarry bar or gadder. When broaching is to be done, the wall between these closely-spaced, parallel holes is broken out by means of a broaching bit in the drill.



A "Lewis Hole" Tripod

In place of the usual saddle is a heavy cast frame with a slot in which a sliding saddle moves, fitting the shell cone. The travel of the saddle in the frame permits drilling three or four holes without moving the tripod. The saddles may be furnished

to fit either Ingersoll or Rand types of drills.

The "Ingersoll" Saddle

This is retained only for old customers who prefer it, and for use with "Eclipse" drills and the larger sizes of the "New Ingersoll" drill. The shell and saddle are held together by a central bolt. Usually it is a part of the "Ingersoll" tripod, but may be furnished on the "Sergeant" tripod on order.

ROCK DRILL MOUNTINGS AND ACCESSORIES

List of Stanpard "Sergeant," "Quadrant," and "Lewis Hole" Tripods for "Sergeant," "Arc Valve Tappet," "New Ingersoll," "Eclipse" and "Electric Air" Drills

Type	Size Letter (Symbol)	Used for Drills, Cylinder Diameter	Net Weight, Pounds			Price Complete	Telegraph Name	
			Tripod	Weights	Tripod Complete, and Weights		With Sergeant Saddle	With Ingersoll Saddle
Sergeant.....	A-27	2"	90	130	220	\$35.00	Labrusque	Labalben
Sergeant.....	A-86	2 1/4"	145	255	400	45.00	Labundum	Labung
Sergeant.....	B-27	2 1/2"	160	255	415	55.00	Laburno	Labutacao
Sergeant.....	D-27	2 3/4", 3"	174	336	510	60.00	Lacausade	Lacayuno
Sergeant.....	E-27	3", 3 1/8", 3 1/4"	324	336	560	65.00	Lacchetta	Lacchizzo
Sergeant.....	F-27	3 1/2", 3 5/8"	296	370	666	75.00	Lacofilo	Laccos
Sergeant.....	G-27	4 1/4", 4 1/2", 5"	315	370	685	85.00	Laccaran	Lacedacmon
Ingersoll.....	A-1	2", 2 1/4"	60	120	180	35.00	.....	Laceroso
Ingersoll.....	D-4	2 3/4"	160	285	445	60.00	.....	Lacernatam
Ingersoll.....	F-3	3 1/2", 3 5/8"	160	336	496	75.00	.....	Lacertilia
Quadrant.....	H-2	4 1/4", 4 1/2", 5"	300	370	670	85.00	.....	Lacertus
Lewis Hole.....	E-25-27	3", 3 1/8", 3 1/4"	250	336	586	75.00	Lacceset	.....
Lewis Hole.....	F-25-27	3 1/2", 3 5/8"	320	370	690	85.00	Lacetani	.....

NOTE.—The Sergeant Saddle is standard and is the form sent with all Sergeant Tripods unless otherwise specified. Sergeant Tripods are always supplied with saddle to mount the type of drill furnished.

List of Standard "Rand Adjustable" and "Lewis Hole" Tripods
for "Little Giant" and "Slugger" Drills

Type	Size	Used for Drills, Cylinder Diameter	Net Weights, Pounds			Price Complete	Telegraph Name
			Tripod	Weights	Tripod Com- plete, with Weights		
Adjustable Tripod.....	No. 0	1 $\frac{7}{8}$ " 2"	80	102	182	\$35.00	Laceraba
Adjustable Tripod.....	No. 1*	2 $\frac{1}{4}$ "	90	210	300	45.00	Laceradora
Adjustable Tripod.....	No. 2	2 $\frac{3}{4}$ "	150	309	459	60.00	Lacerarian
Adjustable Tripod.....	No. 3	3 $\frac{1}{8}$ ", 3 $\frac{3}{8}$ ", 3 $\frac{1}{4}$ "	181	345	526	65.00	Lacerate
Adjustable Tripod.....	No. 4	3 $\frac{5}{8}$ "	333	399	732	75.00	Laceratore
Adjustable Tripod.....	No. 5	3 $\frac{5}{8}$ ", 4 $\frac{1}{2}$ "	437	573	1010	85.00	Laceravate
Lewis Hole Tripod.....	No. 3	3 $\frac{1}{8}$ ", 3 $\frac{3}{8}$ ", 3 $\frac{1}{4}$ "	205	345	550	75.00	Lacewoman
Lewis Hole Tripod.....	No. 4	3 $\frac{5}{8}$ "	360	399	759	85.00	Lachanizo

*The "Little Giant" "1D Light" Drill with 2 $\frac{1}{4}$ inch Cylinder is mounted on a No. 0 Tripod Clamp.

Columns and Arms

The column mounting is furnished in two styles. The double screw column has two jack-screws at one end, with a rosette at the other. It is usually used in connection with a column arm, clamped upon the column and turning about it, and bearing a clamp and saddle carrying the drill. The single-screw column — sometimes called a shaft bar — has a rosette, but only one jack-screw, central with the column.

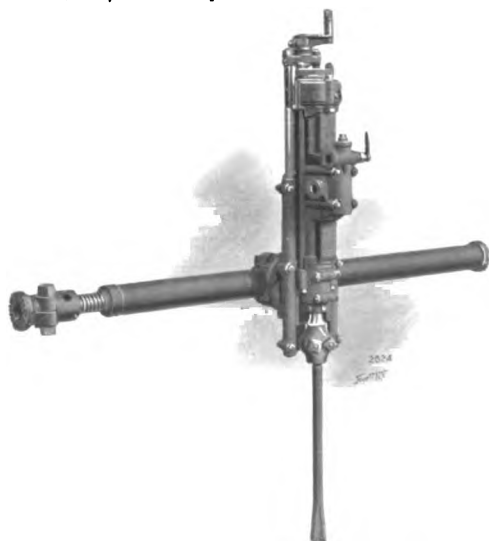


"Sergeant" Single Screw Column, with Clamp



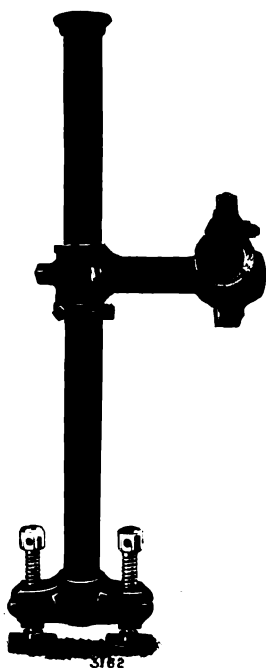
Special "Sergeant" Double Screw Broaching Column

With the double-screw



"Rand" Single Screw Column

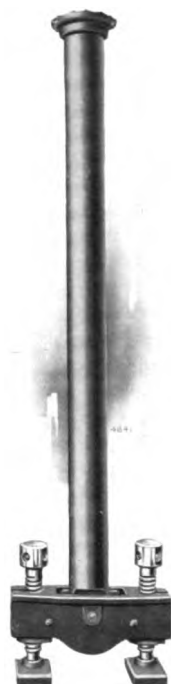
column one or more clamps bearing drills may be mounted on the column arms, or on the column direct. A safety clamp on the column below the arm prevents the latter from falling when it is loosened to swing in any direction. With the single-screw column, however, the arm is frequently omitted, the clamp carrying



"Sergeant" Double Screw Column with Arm Clamp and Safety Clamp

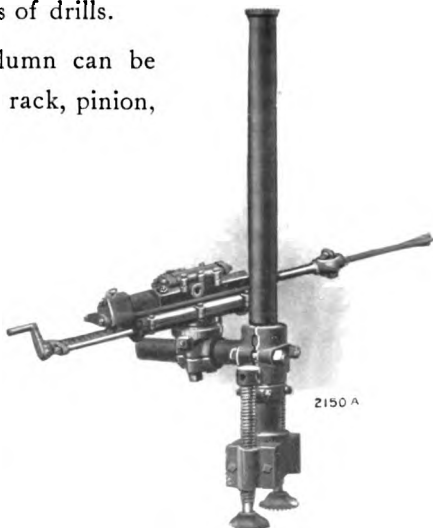
the drill being mounted on the column direct, with the safety clamp below.

Ingersoll-Rand columns are offered in both Rand and Ingersoll types, differing only in minor construction details. Ingersoll columns carry clamps with either "Sergeant" or "Ingersoll" saddles, fitting only the Ingersoll types of Ingersoll-Rand drills. The "Sergeant" saddle, however, is standard and will be furnished unless otherwise ordered. Rand columns are fitted with "Rand" saddles for Rand types of drills.



Double Screw Swing Base Column

A special broaching column can be furnished on order, with a rack, pinion, spline and feed clamp, by which broaching may be done. In addition to the standard sizes of columns listed in the table, the Company is prepared to furnish extra long columns, and special combinations of columns, arms and clamps.



"Rand" Double Screw Column

List of Sergeant Single and Double Screw Columns for "Sergeant," "Arc Valve Tappet," "New Ingersoll," "Eclipse" and "Electric Air" Drills

Type	Outside Diameter	Min. Length Screws Run in, Feet	Suitable for Drills, Cylinder Diameter	Approximate Weights			Price Complete with Arm and Clamp.	Telegraph Names Complete
				Column Com- plete, Lbs.	Arm, Clamp and Safety Clamp			
					5' Cone	7' Cone		
Double Screw Column.	3"	6'	2" to 2½"	140	60	95	\$45.00	*Laadah
Double Screw Column.	3"	8'	2" to 2½"	156	60	95	45.00	*Laagstam
Double Screw Column.	3½"	6'	2¼", 2½"	227	95	110	55.00	*Laadband
Double Screw Column.	3½"	8'	2¼", 2½"	247	95	110	55.00	*Laadboom
Double Screw Column.	4"	6'	2½", 2¾"	258	110	125	60.00	*Laakbaas
Double Screw Column.	4"	8'	2½", 2¾"	283	110	125	60.00	*Laaksters
Double Screw Column.	4½"	6'	2¾" to 3¼"	344	...	165	70.00	*Laadbus
Double Screw Column.	4½"	8'	2¾" to 3¼"	374	...	165	70.00	*Laakziek
Double Screw Column.	5½"	6'	3½", 3¾"	410	...	185	73.00	*Laadgaten
Double Screw Column.	5½"	8'	3½", 3¾"	450	...	185	73.00	*Laakzucht
Single Screw Column.	3"	6'	2" to 2½"	95	30	...	35.00	*Labrone
Single Screw Column.	3"	8'	2" to 2½"	110	30	...	35.00	*Labefy
Single Screw Column.	3½"	6'	2¼" to 2¾"	155	45	...	42.00	*Labrotto
Single Screw Column.	3½"	8'	2¼" to 2¾"	175	45	...	42.00	*Labefying
Single Screw Column.	4"	6'	2½" to 2¾"	185	50	...	46.00	*Labeatium
Single Screw Column.	4"	8'	2½" to 2¾"	210	50	...	46.00	*Labekuehle
Single Screw Column.	4½"	6'	2¾" to 3¼"	230	...	85	55.00	*Labefacti
Single Screw Column.	4½"	8'	2¾" to 3¼"	260	...	85	55.00	*Labellorum
Single Screw Column.	5½"	6'	3½", 3¾"	310	...	95	60.00	*Labefactum
Single Screw Column.	5½"	8'	3½", 3¾"	350	...	95	60.00	*Labendes

The length of column should always be specified as closed, i. e., with the screws clear in. Always allow from 10 to 14 inches for wood blocking.
 Prices of Single Screw Columns complete do not include arm, which is not advised nor sent unless specified.
 Longer or shorter columns than those listed will be furnished when ordered.
 These weights and prices include Column Arms of the same diameter as the Column, which will be furnished unless otherwise specified except 5½-inch.
 †Standard 5½-inch Column has 4½-inch Arm and 4½-inch Clamp; if wanted with 5½-inch Arm and 5½-inch Clamp, Price \$77.00.
 If arm and clamp are not wanted, it should be so specified. *With 5-inch cone clamp; all others 7-inch clamp.

List of "Rand" Single and Double Screw Columns for "Little Giant" and "Slugger" Drills

Type	Outside Diameter	Min. Length Screws Run in, Feet	Suitable for Drills, Cylinder Diameter	Approximate Weights			Price Complete with Arm and Clamp	Telegraph Names Complete
				Column Pipe Complete, lbs.	Arm and Clamp lbs.	Total Weight lbs.		
Double Screw Column....	2 3/8"	6'	1 7/8"	59	36	95	\$40.00	Mauvaises
Double Screw Column....	2 3/8"	8'	1 7/8"	66	36	102	40.00	Mavortium
Double Screw Column....	2 7/8"	6'	1 7/8"	84	45	129	45.00	Mauveine
Double Screw Column....	2 7/8"	8'	1 7/8"	86	45	131	45.00	Mawkish
Double Screw Column....	4"	6'	2 1/4"	100	72	172	60.00	Mavolo
Double Screw Column....	4"	8'	2 1/4"	111	72	183	60.00	Mawishly
Double Screw Column....	4 1/2"	6'	2 1/4" to 3 1/4"	187	125	312	66.00	Mavolunt
Double Screw Column....	4 1/2"	8'	2 1/4" to 3 1/4"	208	125	333	66.00	Mawmet
Double Screw Column....	4 1/2"	6'	2 1/4" to 3 1/4"	195	134	329	70.00	Mavorcio
Double Screw Column....	4 1/2"	8'	2 1/4" to 3 1/4"	216	134	350	70.00	Mawmetry
Double Screw Column....	5 1/2"	6'	3 5/8"	358	182	540	77.00	Mavortia
Double Screw Column....	5 1/2"	8'	3 5/8"	387	182	569	77.00	Mawworm
Single Screw Column....	2 3/8"	6'	1 7/8"	45	17	62	31.00	Maxima
Single Screw Column....	2 3/8"	8'	1 7/8"	53	17	70	31.00	Maximize
Single Screw Column....	2 7/8"	6'	1 7/8"	64	19	83	35.00	Maximano
Single Screw Column....	2 7/8"	8'	1 7/8"	76	19	95	35.00	Maximizing
Single Screw Column....	4"	6'	2 1/4" to 3 1/4"	123	45	168	48.00	Maximianus
Single Screw Column....	4"	8'	2 1/4" to 3 1/4"	140	45	186	48.00	Maximorum
Single Screw Column....	4 1/2"	6'	2 1/4" to 3 1/4"	140	54	193	55.00	Maximilian
Single Screw Column....	4 1/2"	8'	2 1/4" to 3 1/4"	160	54	214	55.00	Maxyer
Single Screw Column....	5"	6'	3 5/8"	182	74	256	60.00	Maximist
Single Screw Column....	5"	8'	3 5/8"	223	74	297	60.00	Mayada
Single Screw Column....	5"	8'	2 3/4" to 3 1/4"	182	188	370	86.00	Mayoreses
Shaft Bar (one arm and clamp for 1 drill)....	5"	8'	2 3/4" to 3 1/4"	182	191	373	90.00	**Mayorgado
Shaft Bar (arms and clamps for 2 drills)....	5"	10'	2 3/4" to 3 1/4"	264	376	*951	169.50	Mayorista
	5"	10'	2 3/4" to 3 1/4"	264	382	*957	177.50	**Mayormente

*"Little Giant" 1D Light Drill with 2 1/4-inch Cylinder is mounted on a 2 1/8-inch Column.

**Includes 2 Arms, Center Legs and Weights.

†With 4-inch Arm and 4-inch Clamp.

Other two with 4-inch.

Arm Clamp.

4 1/2-inch Arm and 4 1/2-inch Arm Clamp.

"Sergeant" Column Clamps, Column Arms and Safety Clamps

Column Clamps			Column Arms			Safety Clamps		
Size of Clamp	Size of Cone	Weight lbs.	Telegraph Name	Size	Size Column to be used with	Weight lbs.	Telegraph Name	Weight lbs.
3"	5"	25	Kursaelen	3"	3"	30	Kursattel	6
3 1/2"	5"	40	Kurznasig	3 1/2"	3 1/2"	50	Kussenveer	7
3 1/2"	7"	55	Kurzoehrig	3 1/2"	4"	60	Kwanselen	8
4"	5"	40	Kutschers	4"	4 1/2"	80	Kwikbad	9
4"	7"	55	Kutschlade	4 1/2"	5 1/2"	90	Kwistgoed	10
4 1/2"	7"	75	Kwelziek	5 1/2"				
5 1/2"	7"	85	Kwilpillen					

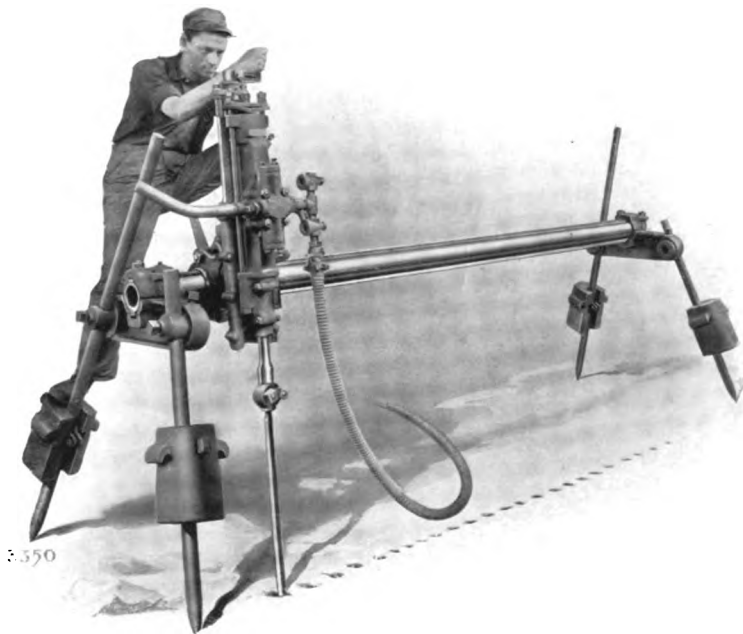
"Rand" Column Clamps, Column Arms and Safety Clamps

Column Clamps			Column Arms			Safety Clamps		
Size	Weight lbs.	Telegraph Name	Size	Column	Weight lbs.	Telegraph Name	Size	Weight lbs.
2 3/8"	17	Marmolino	2 3/8"	2 3/8"	19	Marmoramus	2 3/8"	3
2 7/8"	19	Marmosets	2 7/8"	2 7/8"	26	Marmouser	2 7/8"	3 1/2
4"	27	Marotisme	4"	4"	45	Marouffe	4"	9
*4"	45	Marquisdom	4 1/2"	4 1/2"	80	Marrers	4 1/2"	11
4 1/2"	54	Marsaune	4 1/2"	4 1/2"	80	Marsdrager	4 1/2"	11
5"	74	Marspiter	5"	5 1/2"	108	Marssteng	5 1/2"	15

* For use with 4 1/2-inch column having 4-inch arm.

The Quarry Bar

The Quarry Bar is a standard type of drill mounting finding its largest application in stone quarrying. In materials having well-defined cleavage lines, this mounting is used in breaking out blocks by the plug-and-feather method and "lofting." In granite and similar materials, where the wedge system of breaking cannot be used, "broaching" is resorted to. This operation consists in



The Standard Ingersoll-Rand Quarry Bar

breaking out, by means of a special broaching bit, the thin walls between a row of closely spaced holes drilled along the plane on which the break must be made.

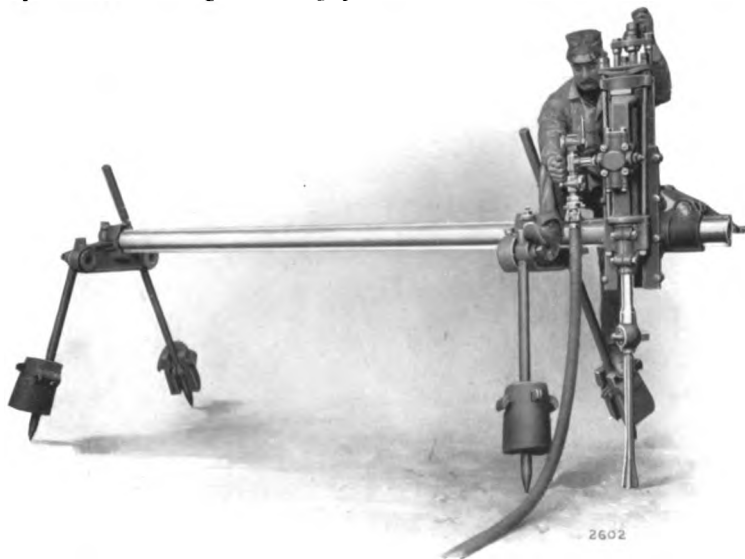
The quarry bar has also been used to great advantage in certain classes of contract work, as in sinking foundations in rock where it is necessary to maintain a smooth side wall.

In this class of work it is important that all the drill holes shall be in one plane, otherwise a clean break cannot be made. If a tripod is used for this, inequalities in the surface are almost sure to cause an irregular row of holes and a ragged break.

ROCK DRILL MOUNTINGS AND ACCESSORIES

The special feature of the quarry bar is that all holes drilled from it are parallel and in the same plane. They may be spaced at any distance by simply moving the drill along the bar. For plug-and-feather work and "lofting" a row of holes is drilled to the desired depth and the break made by means of wedges. Sometimes it is necessary to drill these holes the full depth of the break desired. Sometimes the holes need be only comparatively shallow. In other cases deep and shallow holes alternately will do the work. Experience alone can determine the best method in any particular case. When "broaching" is to be done, a drill with a "release rotation" must be used, as the broaching bit must not rotate.

The Ingersoll-Rand Quarry Bar combines great strength and rigidity with a wide flexibility of adjustment for difficult set-ups. The leg posts turn on the end pieces and the legs have sliding adjustment through the leg posts. The bar is a tube of extra



The Ingersoll-Rand Quarry Bar, Illustrating the Use of the Drill at the End of Bar heavy steel, with a rack-and-pinion for causing the longitudinal travel of the carriage and a spline to prevent the carriage turning on the bar. The saddle clamp carrying the drill, however, turns on the carriage, so that parallel holes can be drilled in any plane from horizontal to vertical.

ROCK DRILL MOUNTINGS AND ACCESSORIES

When necessary to carry the line of holes close to a bench, the end piece and legs nearest the bench are moved in along the bar and the drill and carriage mounted beyond. In this way the row of holes can be carried to the extremity of the bar without loss of alignment.

The Ingersoll-Rand Quarry Bar is furnished complete with holding-down weights, carriage, saddle clamp, and the necessary wrenches. A drill, however, is not a part of the regular equipment. In ordering, the length of the quarry bar wanted should be clearly specified, together with the size and type of the drill which it is proposed to use. A general statement of the character of the work to be done will also be of material assistance to the Company in properly filling an order.

Ingersoll-Rand Quarry Bars

Size	Length of Bar over all	Length of Cut	Can be used with the following sizes of drills Cylinder diameter	Weight with weights but without drill	List Price	Telegraph Names	
						With 5-inch Clamp	With 7-inch Clamp
Light 3-inch	10'	8' 4"	2 2¼ *2½	860 lbs.	\$200.00	Lachziek	Laciez
Standard 4½-inch	12'	10'	*2¼ 2½ 2¾ 3 3¼ 3½ 3⅝	1460 lbs.	\$250.00	Lacientis	Laciniada

*Complete Quarry Bar includes Carriage, Weights and Wrenches, but no Drill.

*When a 2½-inch Drill is used on the 3-inch Light Quarry Bar, or a 2¼-inch Drill is used on the 4½-inch Standard Quarry Bar, a special saddle is necessary.

Shorter bars than those above listed will be furnished at the same price.

Price includes a complete bar with carriage, weights and wrenches, but no drill. For price with drill add to the above price of bar the list price of the drill to be used.

When a drill is wanted to go with a quarry bar, give telegraph name of bar followed by telegraph name of drill wanted, unmounted.

For sizes, prices and telegraph names of drills, see separate pamphlets, sent on request. For price of broaching steels for use with quarry bar, add one-third to the prices of standard rock drill steels listed on pages 19 to 24.

The Gadder

The Gadder is a special rock drill mounting designed for quarry work where a number of parallel holes are to be drilled in a plane, from nearly horizontal to vertical. Used in connection with the channeler, it is applied in "lofting," or drilling the horizontal under-cutting holes in material which has been channeled, to free it from the bed. It is also used in "plug-and-feather" work for breaking the large blocks channeled.

The machine is a heavy cast truck on wheels, with a hinged standard adjustable by a screw and hand-wheel from nearly horizontal to vertical. A saddle carrying a rock drill and shell slides in the gadder standard, being raised or lowered by means of a chain, sheave and drum. With the drill in proper position, a powerful wedge clamp grips the saddle in place. Anchor pins at the corners of the truck may be driven into the rock surface to maintain position.



Standard Ingersoll-Rand Gadder

ROCK DRILL MOUNTINGS AND ACCESSORIES

A special drill shell and feed screw with a travel of three feet can be furnished on demand. The gadder uses drills of "C," "D," or "E" size ($2\frac{3}{4}$, 3 or $3\frac{1}{4}$ inches) and drills of any model may be used. The "C-97" Gadder Drill is the machine usually used with the gadder. This is a modified "Sergeant" drill type, with $2\frac{3}{4}$ -inch cylinder and a 36-inch feed. It is specially designed for very close work, having three supply connections.

The gadder equipment includes a truck with corner pins; one standard back screw, one long back screw, and one short back screw for frame; one 8-foot tie rod; full set of oilers and wrenches.

Price of gadder complete with drill, hose, steels, etc., is obtained by adding together the price of gadder here given, the price of drill (see separate pamphlets) and the price of accessories given later.

Equipment furnished with each Gadder Frame

One truck with corner pins.

One standard back screw, one long back screw and one extra short back screw for frame.

One full set of oilers.

One full set of wrenches.

One tie rod eight feet long.

Net price of Gadder Frame, \$400.00 f. o. b. Factory.

Net price of "C-97" Gadder Drill, \$165.00 f. o. b. Factory.

Net weight of Gadder Frame, without drill or fittings, 2,550 pounds.

Telegraph name of Gadder Frame, **Learnedly**.

Telegraph name of "C-97" Gadder Drill, **Leasehold**.

Telegraph name of Gadder Frame, complete, with "C-97" Drill, **Leasow**.

Price of the gadder, complete with drill, steels and hose, is obtained by adding the prices of the drill, steels and hose to that of the gadder frame.

Approximate shipping weight of gadder complete with drill:

Class of drill: "C" "D" "E"

3125 3140 3155 pounds.

Rock Drill Steels

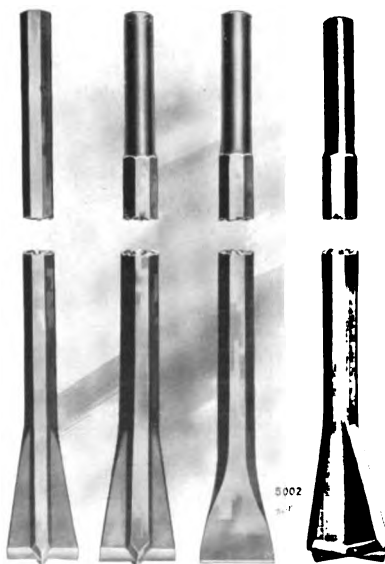
Ingersoll-Rand rock drill steels are of the best quality to be had. The loss of gage on the bit varies with the material drilled; it is very rapid in hard and gritty rocks, and diminishes as the rock decreases in hardness. The difference in length between successive steels in a run is of course determined by the drill feed. Usually it is not more than two feet and may be much less; or it can be more when the conditions make it desirable. The change from one length to the next longer one presents a new, sharp cutting bit to the rock, and the rate of drilling is fairly uniform over the full depth of the hole.

A "set of steels" consists of a series of increasing lengths, the number depending upon the length of feed and the depth of the hole. The shortest length or "starter," will usually be about two feet. The diameter of bit diminishes as length increases, so that the gage of the starter will depend upon the depth of hole and the bottom diameter sought.

A set of steels is always understood to mean one piece of each length up to the desired maximum. At least two sets should be

ordered with each drill, so that one may be sharpened while the other is in use. A greater number of sets than two is often an advantage, particularly in gritty rock.

In the tables of standard drill steels following, the lengths designated in heavy faced type are those which make up the set on orders for sets where no special number of lengths is designated. *In ordering drill steels, therefore, care must be taken to specify distinctly whether a set, duplicate set, or single steels are desired; also the maximum depth of hole which it is intended to drill.*



Rock Drill Steels with and without Shanks, showing Standard Bits

ROCK DRILL MOUNTINGS AND ACCESSORIES

Standard "Ingersoll" Drill Steels for "Sergeant," "Arc Valve Tappet," "New Ingersoll," "Eclipse" and "Electric Air" Drills

A²⁴			Shank $\frac{3}{4}$ x $3\frac{1}{4}$ inches Feed 12 inches		2-inch "Sergeant" Drill		
Length of each Steel not including Shank	Diameter of Standard Bit	Size of Steel	Weights		Prices		Telegraph Name of Set (See Note page 21)
			Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1'	$1\frac{1}{8}"$	$\frac{3}{4}"$	2 $\frac{1}{2}$	..	\$1.30	....	Leastways
2'	$1\frac{1}{8}"$	$\frac{3}{4}"$	4 $\frac{1}{2}$	7	1.54	\$2.84	Leastwise
3'	$1\frac{1}{8}"$	$\frac{3}{4}"$	7	14	1.84	4.68	Leathesie
4'	$1\frac{1}{8}"$	$\frac{3}{4}"$	8	22	1.96	6.64	Leaveless
5'	$1\frac{1}{8}"$	$\frac{3}{4}"$	9	31	2.16	8.80	Leaveneth

A³² 35			Shank $\frac{3}{4}$ x 5 inches Feed 15 inches		2 $\frac{1}{4}$ -inch "Arc Valve Tappet" "Baby" 2-inch "Sergeant" "Light Mining"		
Length of each Steel not including Shank	Diameter of Standard Bit	Size of Steel	Each Steel Lbs.	Set Lbs.	Each Steel	Set	Telegraph Name of Set
1' 3"	$1\frac{1}{8}"$	$\frac{3}{4}"$	3	..	\$1.56	....	Leavening
2' 6"	$1\frac{1}{8}"$	$\frac{3}{4}"$	5	8	1.80	\$3.36	Leavenous
3' 9"	$1\frac{1}{8}"$	$\frac{3}{4}"$	7	15	2.04	5.40	Lebadeam
5' 5"	$1\frac{1}{8}"$	$\frac{3}{4}"$	9	24	2.28	7.68	Lebaniego
6' 3"	$1\frac{1}{8}"$	$\frac{3}{4}"$	11	35	2.52	10.20	Lebban
7' 6"	$1\frac{1}{8}"$	$\frac{3}{4}"$	14	49	2.88	13.08	Lebbeus
8' 9"	$1\frac{1}{8}"$	$\frac{3}{4}"$	18	67	3.36	16.44	Lebbiger
10'	$1\frac{1}{8}"$	$\frac{3}{4}"$	23	90	3.96	20.40	Lebbigheid

A ³⁵ Special 50 B ¹⁰⁴ 86			Shank 7/8 x 5 inches Feed 15 inches		2-inch "Sergeant" Special 2 1/4-inch "Arc Valve Tappet" 2 1/4-inch "Sergeant"		
3 C—Electric Air							
1' 3"	1 1/8"	3/8"	4	..	\$1.68	....	Lebbrolina
2' 6"	1 5/8"	7/8"	7	11	2.04	\$3.72	Lebbroso
3' 9"	1 1/2"	3/4"	9	20	2.28	6.00	Lebeche
5' 5"	1 5/8"	3/4"	12	32	2.64	8.64	Lebedum
6' 3"	1 3/4"	3/4"	14	46	2.88	11.52	Lebehoch
7' 6"	1 1/2"	7/8"	16	62	3.12	14.64	Lebemann
8' 9"	1 1/4"	7/8"	18	80	3.36	18.00	Lebemannes
10'	1 1/4"	7/8"	23	103	3.96	21.96	Lebemensch

B² 9 B¹⁰⁴ 24 32			Shank $\frac{7}{8}$ x 5 inches Feed 20 inches		2 $\frac{1}{2}$ -inch Ingersoll "Eclipse" 2 $\frac{1}{2}$ -inch "New Ingersoll" 2 $\frac{1}{2}$ -inch "Sergeant" 2 $\frac{1}{2}$ -inch "Arc Valve Tappet"		
Length of each Steel not including Shank	Diameter of Standard Bit	Size of Steel	Each Steel Lbs.	Set Lbs.	Each Steel	Set	Telegraph Name of Set
1' 8"	$1\frac{1}{8}"$	1"	6	..	\$1.92	....	Lebendig
3' 4"	$1\frac{1}{8}"$	1"	11	17	2.52	\$4.44	Lebendiger
5'	$1\frac{1}{8}"$	$\frac{3}{4}"$	13	30	2.76	7.20	Lebensader
6' 8"	$1\frac{1}{8}"$	$\frac{3}{4}"$	16	46	3.12	10.32	Lebensbahn
8' 4"	$1\frac{1}{8}"$	$\frac{3}{4}"$	20	66	3.60	13.92	Lebensbaum
10'	$1\frac{1}{4}"$	$\frac{7}{8}"$	23	89	3.96	17.88	Lebensbild
11' 8"	$1\frac{1}{4}"$	$\frac{7}{8}"$	29	118	4.68	22.56	Lebensende

See NOTES, Page 21.

ROCK DRILL MOUNTINGS AND ACCESSORIES

B¹⁰⁵C⁶			Shank 1 x 5½ inches Feed 24 inches		2¾-inch Ingersoll "Eclipse" 2¾-inch "New Ingersoll" 2¾-inch "Sergeant" 2¾-inch "Arc Valve Tappet"		
4E—Electric Air							
Length Ea. Steel not including Shank	Diam. of Stand'd Bits	Size of Steel	Weights		Prices		Telegraph Name of Set (See Note, page 21)
			Each St'l Lbs.	Set Lbs.	Each Steel	Set	
2'	2¼"	1½"	10		\$2.40		Lebensfroh
4'	2½"	1½"	17	27	3.24	\$5.64	Lebensholz
6'	2"	1"	20	47	3.60	9.24	Lebensjahr
8'	1¾"	1"	25	72	4.20	13.44	Lebensjoch
10'	1¾"	1"	29	101	4.68	18.12	Lebenskost
12'	1¾"	1"	36	137	5.52	23.64	Lebenslauf
14'	1½"	1"	42	179	6.24	29.88	Lebenslust
16'	1½"	1"	48	227	6.96	36.84	Lebensmai
18'	1½"	1"	60	287	8.86	45.70	Lebensmuth
20'	1½"	1"	70	357	10.06	55.76	Lebensoel
22'	1½"	1"	75	432	10.66	66.42	Lebenspfad
24'	1½"	1"	85	517	11.86	78.28	Lebensplan

D⁹E^{3 32}			Shank 1½ x 6 inches Feed 24 inches		3⅞-inch Ingersoll "Eclipse" 3⅞ and 3¼-inch "New Ingersoll" 3 and 3¼-inch "Sergeant" 3⅞ and 3¼-inch "Arc Valve Tappet"		
5C—Electric Air 52							
2'	2½"	1¼"	12	..	\$2.78	.....	Lebensreiz
4'	2½"	1¼"	20	32	3.74	\$6.52	Lebenssaft
6'	2½"	1½"	24	56	4.22	10.74	Lebenssatz
8'	2½"	1½"	31	87	5.06	15.80	Lebenstag
10'	2"	1½"	40	127	6.14	21.94	Lebenswahr
12'	1¾"	1½"	49	176	7.22	29.16	Lebensweg
14'	1¾"	1½"	53	229	7.70	36.86	Lebenswelt
16'	1½"	1½"	63	292	8.90	45.76	Lebenszeit
18'	1½"	1½"	76	368	10.78	56.54	Lebensziel
20'	1½"	1½"	82	450	11.50	68.04	Lebenvoll
22'	1½"	1½"	88	538	12.22	80.26	Leberader
24'	1½"	1½"	95	633	13.06	93.32	Leberaloe
26'	1½"	1½"	105	738	14.26	107.58	Leberblume
28'	1½"	1½"	117	855	15.70	123.28	Leberbraun
30'	1½"	1½"	130	985	16.26	139.54	Leberbruch

F^{3 32} 9 94 24 FA		Shank 1¼ x 6 inches Feed 24 inches		3½-inch Ingersoll "Eclipse" 3½-inch "New Ingersoll" 3½ and 3¼-inch "Sergeant" 3½-inch "Arc Valve Tappet"	
2'	2½"	1¾"	14	\$3.02	Leberfisch
4'	2½"	1¾"	24	38 4.22	\$7.24 Leberfleck
6'	2½"	1¾"	30	68 4.94	12.18 Leberfuchs
8'	2½"	1¾"	38	106 5.90	18.08 Lebergalle
10'	2½"	1¾"	49	155 7.22	25.30 Lebergang
12'	2"	1¾"	57	212 8.18	33.48 Leberklee
14'	1¾"	1¾"	68	280 9.50	42.98 Leberkolik
16'	1¾"	1¾"	75	355 10.34	53.32 Leberkraut
18'	1¾"	1¾"	85	440 11.86	65.18 Lebermoose
20'	1¾"	1¾"	96	536 13.18	78.36 Lebernetz
22'	1¾"	1¾"	105	641 14.26	92.62 Leberrinne
24'	1¾"	1¾"	115	756 15.46	108.08 Leberspatz
26'	1¾"	1¾"	125	881 16.66	124.74 Leberstein
28'	1¾"	1¾"	140	1021 18.46	143.20 Lebersucht
30'	1¾"	1¾"	155	1176 20.26	163.46 Leberthran
32'	1¾"	1¾"	165	1341 21.46	184.92 Leberwurm

ROCK DRILL MOUNTINGS AND ACCESSORIES

G ² ³ ⁹ A1 A2	H ² ³ ^{A1} ^{A3}	Shank 1½ x 6½ inches Feed 30 inches	4¼, 4½ and 5-inch Ingersoll "Eclipse" 4¼-inch "New Ingersoll"

Length of each Steel not including Shank	Diameter of Standard Bit	Size of Steel	Weights		Prices		Telegraph Name of Set (See Note Below)
			Each Steel Lbs.	Set Lbs.	Each Steel	Set	
2'	3"	1½"	21	...	\$5.52	...	Leberwurst
4' 6"	2½"	1½"	39	60	7.68	\$13.20	Leberzelle
7'	2½"	1½"	49	109	8.88	22.08	Lebete
9' 6"	2½"	1½"	67	176	11.04	33.12	Lebewohl
12'	2½"	1½"	84	260	13.08	46.20	Lebhaft
14' 6"	2½"	1½"	100	360	16.00	62.20	Lebhaftest
17'	2½"	1½"	120	480	18.40	80.60	Lebhonig
19' 6"	2½"	1½"	136	616	20.32	100.92	Lebias
22'	2"	1½"	158	774	23.96	124.88	Lebidon
24' 6"	2"	1½"	176	950	26.12	151.00	Lebimus
27'	2"	1½"	194	1144	28.28	179.28	Lebkuchen
29' 6"	2"	1½"	212	1356	30.44	209.72	Leblos
32'	2"	1½"	230	1586	32.60	242.32	Lebloser
34' 6"	2"	1½"	248	1834	34.76	277.08	Lebmaag

H ⁹ 17 61	Shank 1¾ x 7 inches Feed 30 inches		5½-inch "New Ingersoll"				
2'	3 ¼"	1 ¾"	27	....	\$8.36	Lebmagen	
4' 6"	3 ½"	1 ¾"	48	75	10.88	\$19.24	Lebracho
7'	3 ¾"	1 ¾"	70	145	13.52	32.76	Lebrada
9' 6"	2 ¾"	1 ¾"	90	235	15.92	48.68	Lebrel
12'	2 ¾"	1 ¾"	114	349	18.80	67.48	Lebresinha
14' 6"	2 ¾"	1 ¾"	136	485	24.32	91.80	Lebrillada
17'	2 ¾"	1 ¾"	160	645	27.20	119.00	Lebrillo
19' 6"	2 ¾"	1 ¾"	180	825	29.60	148.60	Lebrinha
22'	2 ¾"	1 ¾"	204	1029	35.14	183.74	Lebrones
24' 6"	2 ¼"	1 ¾"	232	1261	38.50	222.24	Lebruno
27'	2 ¼"	1 ¾"	253	1514	41.08	263.32	Lebttag
29' 6"	2 ¼"	1 ¾"	264	1778	42.34	305.66	Lebwaare
32'	2 ¼"	1 ¾"	302	2080	46.90	352.56	Lebynthos
34' 6"	2 ¼"	1 ¾"	326	2406	52.44	405.00	Lebzeiten
37'	2 ¼"	1 ¾"	350	2756	55.32	460.32	Lecanactis
39' 6"	2 ¼"	1 ¾"	374	3130	58.20	518.52	Lecananto
42'	2 ¼"	1 ¾"	398	3528	61.08	579.60	Lecanora

NOTES—A SET CONSISTS OF ONE STEEL OF EACH LENGTH. Each code word, as given in the table, refers to ONE FULL SET up to the length opposite that word.

In ordering drill steels be sure to specify whether X, +, Z, or sandstone bits are wanted. Cross (+) bits will be furnished unless otherwise ordered.

Steels in "C" sizes (see top of page 20) are furnished on special order for "D" drills when bushing is changed to correspond.

Steels listed in heavy type are STANDARD SIZES and are known as stock steels, and will be shipped unless length is specified; all other lengths, given in LIGHT TYPE, are SPECIAL and are made to order. When a set of steels longer than given in heavy type in above list is ordered, the bit of the longest special steel is made the diameter as given in the table for longest stock steel, and the bit diameters on all shorter steels are increased ⅛-inch for each steel to maintain the same ratio of diameters. All stock steels having the same size shank and length of run are the same, regardless of the drill for which used. When ordering steels it is better to order two or more sets, so blacksmith can be sharpening one set while other is in use.

For prices of special broaching steels and bits for broach channeling add one-third to price of regular drill steels of same size and length of shank.

ROCK DRILL MOUNTINGS AND ACCESSORIES

Standard "Rand" Drill Steels for "Little Giant" and "Slugger" Drills

For 2-inch "Little Giant" Drills				Shank $\frac{3}{4}$ x $3\frac{1}{4}$ inches $\frac{3}{4}$ -inch Steel Feed, 12 inches		
Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note page 23)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1'	$1\frac{1}{8}$ "	2.25	.....	\$1.30	.....	Meriggi
2'	$1\frac{3}{8}$ "	3.75	6.0	1.54	\$2.84	Merigiato
3'	$1\frac{5}{8}$ "	5.75	11.75	1.84	4.68	Merigiavi
4'	$1\frac{7}{8}$ "	7.0	18.75	1.96	6.64	Meriggione

For 2-inch "Little Giant" Drills				Shank $\frac{3}{4}$ x 5 inches $\frac{3}{4}$ -inch Steel* Feed, 15 inches		
Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note page 23)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1' 3"	$1\frac{1}{8}$ "	2.8	.....	\$1.56	.....	Merimnete
2' 6"	$1\frac{3}{8}$ "	4.8	7.6	1.80	\$3.36	Merindad
3' 9"	$1\frac{5}{8}$ "	6.8	14.4	2.04	5.40	Meringue
5'	$1\frac{7}{8}$ "	8.8	23.2	2.28	7.68	Meriniden
6' 3"	$1\frac{7}{8}$ "	10.8	34.0	2.52	10.20	Meriologia

For $2\frac{1}{4}$ -inch "Little Giant" Drills				Shank $\frac{3}{4}$ x 5 inches $\frac{3}{4}$ -inch Steel* Feed, 15 inches		
Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note page 23)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1' 3"	$1\frac{1}{2}$ "	3	..	\$1.68	.....	Meriphe
2' 6"	$1\frac{7}{8}$ "	5	8	2.04	\$3.72	Merismatic
3' 9"	$1\frac{5}{8}$ "	7	15	2.28	6.00	Merismorum
5'	$1\frac{5}{8}$ "	9	24	2.64	8.64	Merismos
6' 3"	$1\frac{3}{4}$ "	11	35	2.88	11.52	Meritabo
7' 6"	$1\frac{3}{8}$ "	13	48	3.12	14.64	Meritabunt

For $2\frac{1}{4}$ -inch "Little Giant" Drills				Shank $\frac{3}{4}$ x 5 inches $\frac{3}{4}$ -inch Steel Feed, 18 inches		
Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note page 23)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1' 6"	$1\frac{1}{2}$ "	3.4	.....	\$1.80	.....	Meritames
3'	$1\frac{7}{8}$ "	5.8	9.2	2.04	\$3.84	Meritant
4' 6"	$1\frac{5}{8}$ "	8.2	17.4	2.28	6.12	Meritantem
6'	$1\frac{5}{8}$ "	10.6	28.0	2.52	8.64	Meritavero
7' 6"	$1\frac{1}{4}$ "	13.0	41.0	2.76	11.40	Meritedly
9'	$1\frac{3}{8}$ "	15.4	56.4	3.00	14.40	Merithal

*For $\frac{7}{8}$ -inch steel, add 40 per cent. to weights given for $\frac{3}{4}$ -inch.
See NOTES, Page 23.

ROCK DRILL MOUNTINGS AND ACCESSORIES

For $2\frac{3}{4}$ -inch "Little Giant" Drills
For $2\frac{3}{4}$ -inch "Slugger" Drills

Shank $1 \times 5\frac{1}{2}$ inches
1-inch Steel
Feed, 18 inches

Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note Below)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
1' 6"	$2\frac{1}{4}$ "	7.0	...	\$2.30	...	Meriting
3'	$2\frac{1}{8}$ "	11.5	18.5	2.75	\$5.05	Meritoire
4' 6"	2"	16.0	34.5	3.20	8.25	Meritorios
6'	$1\frac{7}{8}$ "	20.5	55.0	3.65	11.90	Meritory
7' 6"	$1\frac{3}{4}$ "	25.0	80.0	4.10	16.00	Merkbar
9'	$1\frac{5}{8}$ "	29.0	109.0	4.50	20.50	Merkbarer
10' 6"	$1\frac{1}{2}$ "	33.0	142.0	4.90	25.40	Merkdoek
12'	$1\frac{3}{8}$ "	37.0	179.0	5.30	30.70	Merkelijk

For $2\frac{3}{4}$ -inch "Little Giant" Drills
For $2\frac{3}{4}$ -inch "Slugger" Drills

Shank $1 \times 5\frac{1}{2}$ inches
1-inch Steel
Feed, 24 inches

2'	$2\frac{1}{4}$ "	9	...	\$2.40	...	Merkkatoen
4'	$2\frac{1}{8}$ "	15	24	3.24	\$5.64	Merklap
6'	2"	21	45	3.60	9.24	Merkklappen
8'	$1\frac{7}{8}$ "	27	72	4.20	13.44	Merkletter
10'	$1\frac{3}{4}$ "	33	105	4.68	18.12	Merklich
12'	$1\frac{5}{8}$ "	38	143	5.52	23.64	Merklicher
14'	$1\frac{1}{2}$ "	43	186	6.24	29.88	Merklijnen

For $3\frac{1}{8}$ -inch "Little Giant" Drills
For $3\frac{1}{8}$ -inch "Slugger" Drills
For $3\frac{1}{8}$ -inch "Slugger" Drills
For $3\frac{1}{4}$ -inch "Little Giant" Drills
For $3\frac{1}{4}$ -inch "Slugger" Drills

Shank $1\frac{1}{2} \times 6$ inches
 $1\frac{1}{2}$ -inch Steel
Feed, 24 inches

2'	$2\frac{3}{8}$ "	10	...	\$2.78	...	Merkmal
4'	$2\frac{1}{4}$ "	18	28	3.74	\$6.52	Merkmalen
6'	$2\frac{1}{8}$ "	26	54	4.22	10.74	Merknaald
8'	2"	34	88	5.06	15.80	Merkpfahl
10'	$1\frac{7}{8}$ "	42	130	6.14	21.94	Merkstab
12'	$1\frac{3}{4}$ "	49	179	7.22	29.16	Merkteeken
14'	$1\frac{5}{8}$ "	56	235	7.70	36.86	Merkur
16'	$1\frac{1}{2}$ "	63	298	8.90	45.76	Merkurius
18'	$1\frac{3}{8}$ "	70	368	10.78	56.54	Merkwort
20'	$1\frac{1}{4}$ "	77	445	11.50	68.04	Merkwortes

NOTES—A SET CONSISTS OF ONE STEEL OF EACH LENGTH. Each telegraph name, as given in the table, refers to ONE FULL SET up to the length opposite that word.

In ordering drill steels be sure to specify whether X, +, Z, or sandstone bits are wanted. Cross (+) bits will be furnished unless otherwise ordered.

Steels listed in **heavy type** are STANDARD SIZES and are known as stock steels and will be shipped unless length is specified; all other lengths given in **LIGHT TYPE** are SPECIAL and are made to order. When a set of steels longer than given in heavy type in above list is ordered, the bit of the longest special steel is made the diameter as given in the table for longest stock steel, and the bit diameters on all shorter steels are increased $\frac{1}{8}$ -inch for each steel to maintain the same ratio of diameters. All stock steels having the same size shank and length of run are the same, regardless of the drill for which used. When ordering steels it is better to order two or more sets, so blacksmith can be sharpening one set while other is in use.

For prices of special broaching steels and bits for broach channeling, add one-third to price of regular drill steels of same size and length of shank.

ROCK DRILL MOUNTINGS AND ACCESSORIES

For 3 $\frac{1}{8}$ -inch "Little Giant" Drills
 For 3 $\frac{1}{8}$ -inch "Slugger" Drills
 For 3 $\frac{1}{8}$ -inch "Little Giant" Drills
 For 3 $\frac{1}{4}$ -inch "Slugger" Drills

Shank 1 $\frac{1}{8}$ x 6 inches
 1 $\frac{1}{4}$ -inch Steel
 Feed, 24 inches

Length of each Steel not including Shank	Diameter of Standard Bit	Weights		Prices		Telegraph Name of Set (See Note, page 23)
		Each Steel Lbs.	Set Lbs.	Each Steel	Set	
2'	2 $\frac{1}{8}$ "	11	...	\$3.02	.....	Merkzettel
4'	2 $\frac{3}{8}$ "	21	32	4.22	\$7.24	Merkzielen
6'	2 $\frac{1}{2}$ "	31	63	4.94	12.18	Merkzijde
8'	2 $\frac{3}{4}$ "	41	104	5.90	18.08	Merlango
10'	2 $\frac{7}{8}$ "	51	155	7.22	25.30	Merlangus
12'	1 $\frac{1}{4}$ "	60	215	8.18	33.48	Merlarono
14'	1 $\frac{3}{8}$ "	69	284	9.50	42.98	Merlassimo
16'	1 $\frac{1}{2}$ "	78	362	10.34	53.32	Merlata
18'	1 $\frac{5}{8}$ "	87	449	11.86	65.18	Merlatura
20'	1 $\frac{3}{4}$ "	96	545	13.18	78.36	Merlavamo

For 3 $\frac{5}{8}$ -inch "Little Giant" Drills
 For 3 $\frac{5}{8}$ -inch "Slugger" Drills

Shank 1 $\frac{3}{8}$ x 6 $\frac{1}{2}$ inches
 1 $\frac{3}{8}$ -inch Steel
 Feed, 30 inches

2' 6"	3 $\frac{1}{8}$ "	18	...	\$3.80	.....	Merlavate
5'	3 $\frac{3}{8}$ "	32	50	5.20	\$9.00	Merleau
7' 6"	3 $\frac{1}{2}$ "	46	96	6.60	15.60	Merleranno
10'	3 $\frac{3}{4}$ "	60	156	8.00	23.60	Merlerebbe
12' 6"	3"	74	230	9.40	33.00	Merleremo
15'	2 $\frac{3}{8}$ "	87	317	10.70	43.70	Merleresti
17' 6"	2 $\frac{3}{4}$ "	100	417	12.00	55.70	Merlieux
20'	2 $\frac{5}{8}$ "	113	530	16.10	71.80	Merlinammo
22' 6"	2 $\frac{1}{2}$ "	126	656	17.40	89.20	Merlinando
25'	2 $\frac{3}{8}$ "	139	795	18.70	107.90	Merlinassi

For 4 $\frac{1}{2}$ -inch "Little Giant" Drills

Shank 1 $\frac{1}{2}$ x 7 inches
 1 $\frac{1}{2}$ -inch Steel
 Feed, 36 inches

3'	3 $\frac{3}{4}$ "	26	...	\$5.26	.....	Merlinato
6'	3 $\frac{5}{8}$ "	46	72	7.26	\$12.52	Merlinava
9'	3 $\frac{1}{2}$ "	66	138	9.26	21.78	Merliner
12'	3 $\frac{3}{8}$ "	86	224	11.26	33.04	Merlinera
15'	3 $\frac{1}{4}$ "	105	329	13.16	46.20	Merlings
18'	3 $\frac{1}{8}$ "	124	453	18.40	64.60	Merlmeise
21'	3"	142	595	20.20	84.80	Merlonge
24'	2 $\frac{7}{8}$ "	160	755	22.00	106.80	Merlotta

Finished Plug and Feather Bit Steels

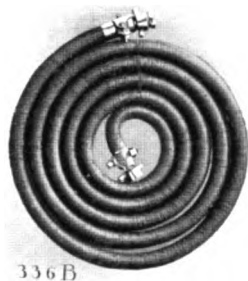
Size	Telegraph Name	Length	Bit	Shank	Weight Pounds	Price
No. 0	Merluche	13"	1 $\frac{1}{8}$ "	$\frac{5}{8}$ x3	1.5	\$0.60
No. 1	Merlucius	20"	1 $\frac{1}{4}$ "	$\frac{3}{4}$ x5	3.5	.80
No. 2	Merluzzo	18"	1 $\frac{1}{4}$ "	1 x5 $\frac{1}{2}$	3.5	1.35
No. 3	Mermadas	18 $\frac{3}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{1}{8}$ x6	4.0	1.50

See NOTES, Page 23.

Air and Steam Hose

The air and steam hose furnished by the Ingersoll-Rand Company is made especially for the Company from the very best materials and for the special purposes for which it is intended. The sizes range from $\frac{3}{4}$ to 3 inches in diameter. It is made with 4, 5, 6, or more plies or wrappings of closely woven duck or canvas, and each style is equal to the pressure for which it is intended. The lining or tubing is of the best Para gum, properly vulcanized

and treated. Several distinct styles of covering or wrapping are offered, among these are: Plain rubber; canvas covered; canvas covered marline wound; canvas covered wire wound; cotton wound and red painted jacket; marline woven jacket; special linen fabric and special linen fabric wire wound.



336 B
Marline-Wound Hose with Couplings

Marline wound hose is wrapped with a tarred marline cord, closely spaced. Wire wound hose is supplied in three styles: round wire; half round wire and flat wire. In all cases the wrapping is of galvanized steel spaced about $\frac{1}{4}$ " between turns. The wire wound hose is particularly suitable for the roughest work in mine, quarrying or contract, where the hose must be dragged around over rocky surfaces. In such cases the wire protects the softer covering or jacket from injury.

Where steam is to be used, marline wound hose



Wire-Wound Hose with Couplings

ROCK DRILL MOUNTINGS AND ACCESSORIES

is usually to be preferred to wire wound, as the latter soon becomes too hot to handle with comfort. Moreover, as the hose expands with the heat and the steam, the wire is likely to cut into the covering with an injury to the hose. Marline wound hose on the contrary will stretch as the hose expands, and there is no injury to the covering.

Where air only is to be used wire wound hose gives the best service. Steam hose may be used for either steam or air; but air hose will not last long if used with steam as the heat has an injurious effect on the lining.

Under no circumstances should oil be fed through the hose unless the tube or lining is of a special oil resisting composition, for oil rapidly destroys an ordinary rubber lining. Where steam is used the hose should be protected by the valve on the end of the pipe line, so that when the hose is not in use it may be freed from heat and pressure by closing this valve. The same application is useful where air is to be used, as it is not advisable to maintain pressure unnecessarily on the hose. But as the valve at the end of the pipe line may leak, it is better to disconnect the hose entirely if it is to lie idle for any length of time.

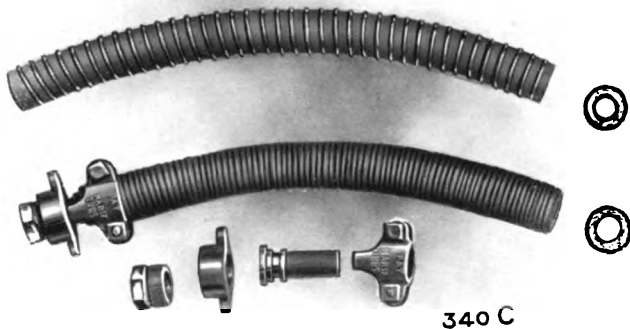
The Company is prepared to furnish hose in any style in standard lengths of 25 and 50 feet. It is never made in lengths above 50 feet, but it will be cut to odd short lengths on order. A 50-foot length is the shortest which is recommended for each drill, as this gives a wider radius of action without losing time in moving or extending pipe lines.

Owing to the great variety of sizes and styles, the Company's standard steam and air hose is not tabulated in this pamphlet. Any desired size, ply or style of covering or wrapping can be furnished on order. Most of them are carried in stock and quick delivery can be made. The larger sizes find their principal application as feeders to smaller hose lines in quarries or headings where it may not be convenient to lay a feed pipe. In such cases the manifold or header as described on page 35 is placed on the end of the large hose line and the smaller hose lines to each drill are taken off from the branch openings.

An order for hose should contain full information on the following points: The diameter of the hose; the length wanted; the pressure to be carried; whether steam or air is to be used; the style of cover (plain, marline, marline-woven or wire wound and style of wire); the number of inside plies; and whether hose is wanted with couplings or without.

Hose Couplings and Menders

The duty of the hose couplings in tunnel excavation work is particularly heavy and unless they are of the best construction they are quickly destroyed. Poor hose couplings not only will not last, but may waste many times their cost each day in the steam or



"Sergeant" Hose Couplings

air leaking through their poor joints. This is a minor detail of economy often overlooked, but of the utmost importance.

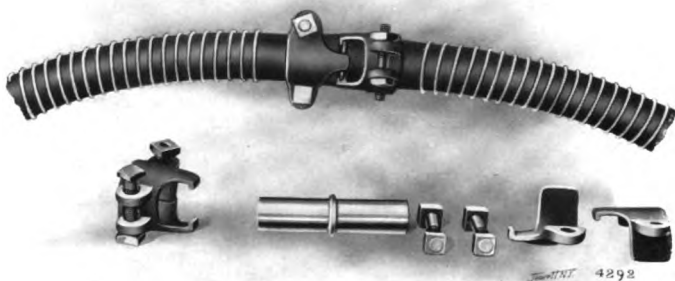
"Sergeant" Hose Couplings

"Sergeant" hose couplings are made for the hardest service and many years of use have proved them to be the best on the market. The materials are of the best quality; they stand the most severe abuse and will hold under the highest pressures without leaking or blowing out.

ROCK DRILL MOUNTINGS AND ACCESSORIES

"Sergeant" Hose Menders

"Sergeant" hose menders are very similar in design to the regular hose coupling and have all the good qualities of the standard couplings. They use the regular hose clamps and bolts, but the coupling stem and spud are replaced by a single mender stem, making a permanent joint.



"Sergeant" Hose Menders

Hose Couplings

Size	Complete with Spud			Size	Spud Alone		
	Price	Weight	Telegraph Name		Price	Weight	Telegraph Name
1/2"	\$1.50	2lb. 8oz.	Lectitabis	1/2"	\$.35	9oz.	Lectitamus
3/4"	1.50	2lb. 11oz.	Lectricem	3/4"	.35	10oz.	Lectricis
1"	1.75	2lb. 13oz.	Lectulos	1"	.45	11oz.	Lecturing
1 1/4"	2.50	4lb. 5oz.	Ledaeos	1 1/4"	.80	12oz.	Ledanum
1 1/2"	3.00	4lb. 9oz.	Ledepoppen	1 1/2"	1.00	13oz.	Lederafal
2"	5.00	6lb. 1oz.	Lederbloem	2"	2.00	14oz.	Lederfarbe
2 1/2"	6.00	11lb. 13oz.	Lederig	2 1/2"	2.50	2lb. 3oz.	Lederkaese
3"	7.50	15lb. 12oz.	Ledermesse	3"	3.25	3lb.	Lederpolyp

Hose Menders

Size	Price	Weight	Telegraph Name
3/4"	\$1.00	1lb. 12oz.	Ledersohle
1"	1.25	2lb. 8oz.	Ledertuch
1 1/4"	1.50	3lb.	Ledesma

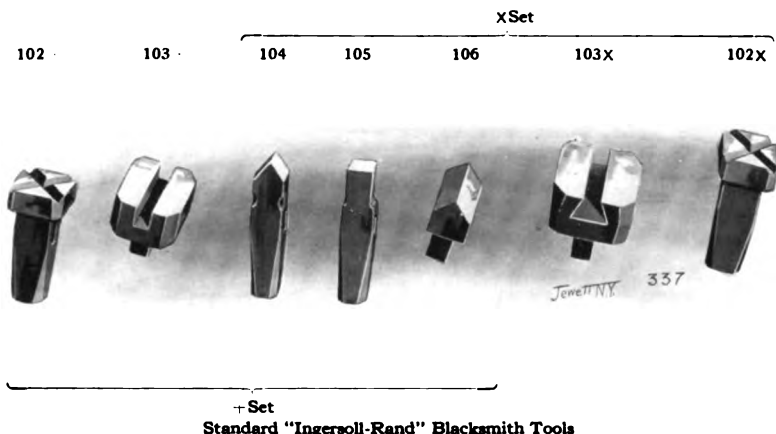
Blacksmith Tools

The proper sharpening of rock drill steels is a very important factor in rock drilling economy. The footage made by a drill depends very largely upon the proper forging and sharpening of

ROCK DRILL MOUNTINGS AND ACCESSORIES

the drill bits. Bits not true to gage result in rifled holes and stuck steels. Bits not properly tempered cut down the drilling rate of the machine. A very valuable discussion of this question of drill bits will be found appended to this pamphlet.

For this important work the Company furnishes the special blacksmith tools here illustrated. They are not a part of a regular drill equipment but will be furnished on order at the prices listed on the following page. While of a special design for this



special class of work, they are in essentials very similar to the ordinary smith tools, and an intelligent blacksmith will quickly master their use and turn out good bits.

Two distinct styles are offered. One is for the (x) shape of bit and the other for the cross (+) bit. The order should specify which style is wanted. Standard smith tools, in either style, are made in three sizes: the "A" size, for drills 2 and $2\frac{1}{4}$ inches in diameter; the "B" size, for drills from $2\frac{1}{2}$ to $3\frac{5}{8}$ inches in diameter; and the "G" size, for drills of $4\frac{1}{4}$ -inch diameter and larger. In special cases still larger tools can be furnished, on order. One set of these smith tools will handle the steels for from one to ten drills.

As sent out these tools are hardened, and ready for use. A standard set consists of sharpening tools only. Swedges for forming shanks on drill steels will be furnished on order, at the prices listed in the table.

ROCK DRILL MOUNTINGS AND ACCESSORIES

Standard Blacksmith Tools for Sharpening Drill Steels

Shop No.	Name	"A" Size		"B" to "F" Size		"G" and "H" Size	
		Price	Telegraph Name	Price	Telegraph Name	Price	Telegraph Name
102	Dolly	\$2.00	Laufpasses	\$2.50	Laufseite	\$3.50	Laufwagen
103	Sow	1.75	Laufplatz	2.25	Laufstock	3.25	Laufzaum
104	Spreader	1.25	Lauftrad	1.25	Laufstuhl	1.25	Laufzeit
105	Flatter	1.00	Laufraeder	1.00	Laufthier	1.00	Laufzeiten
106	Swage	1.00	Lauf ruthe	1.00	Laufuebung	1.00	Laugenbad
Weight of set, + } lbs. X }		16½		+22 > 23		+27 > 33	
Price of set, } Telegraph Name }		\$7.00	Laufschuss	\$8.00	Laufvogel	\$10.00	Laugenfass

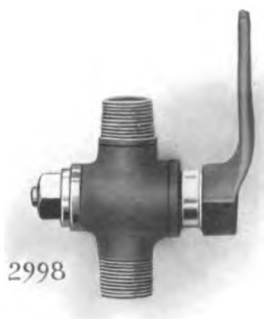
Telegraph name refers to (+) set; if (X) set is wanted follow the word for set by "ex."

Swedges for forming shanks on drill steels are not included in SET of smith's tools.

Extra price, per set, top and bottom, \$2.00; separately, \$1.00 each. Weight, each, 3 lbs.

Rock Drill Throttle Valves

No part of the drill is exposed to more abuse than the throttle valve, and the problem of designing a throttle, which will stand this service and still remain tight, has for many years occupied the attention of drill builders. The two devices here described have been found in this Company's experience, to give entire satisfaction.



The "Old Style" Throttle

The "Old Style" Throttle

This is a strong, heavy, straight-way taper plug valve made of composition metal and designed for rough service. It has not the automatic adjustment of the "New Ingersoll" throttle and wear is taken up by tightening a nut on the end of the taper. It is a satisfactory and reliable device at moderate cost.

The "New Ingersoll" Throttle

This is an improved device of great strength and convenience, automatically adjustable for wear by the pressure and by a spring tension, easily kept tight and working freely at all times. The opening in the taper plug is at such an angle that close regulation is very easily secured. The material used is a special quality of cast steel and each throttle is individually ground and fitted at our factory. For this reason this throttle is a costly device to build and demands a higher price than some operators are willing to pay. For those requiring a cheaper valve, the throttle last described is offered.



The "New Ingersoll" Throttle

Rock Drill Throttle Valves

"New Ingersoll" Throttle			"Old Style" Throttle		
Size	Price	Telegraph Name	Size	Price	Telegraph Name
$\frac{3}{4}$ "	\$3.00	Kourkho	$\frac{3}{4}$ "	\$1.75	Krabschuit
1"	3.50	Kraagjas	1"	2.00	Krabsel
$1\frac{1}{4}$ "	6.00	Kraaland			

NOTE—An excellent practice for operators to follow is to throw the throttle handle in opposite directions on alternate days, thus securing a uniform wear between plug and seat.

Rock Drill Oilers

The adequate lubrication of rock drills is of vital importance in its bearing on the life, capacity, sustained tightness, wear and operation of the machines. Care in looking after this detail, and the use of reliable oilers, will result in material savings. Ingersoll-Rand oilers are the most perfect devices yet made for this work and three styles are described on the following pages.

The "Reservoir" Oiler

This device is made of gun metal and comprises a reservoir of about a half-pint capacity, with a taper plug valve. The reservoir is closed with a screw plug. The taper plug has two cups on opposite sides, each holding about a teaspoonful of oil. One cup is always in communication with the reservoir and filled with oil. A half turn of the handle empties this cup into the supply passage to the drill, and the oil is carried as a spray into the machine. The other cup is filled ready for another turn of the handle. The reservoir holds enough oil for a half-shift's run and the handle should be thrown about every five to ten feet of drilling. Just the right amount of oil is admitted each time, with no loss of oil or pressure.



The "Reservoir" Oiler

The "New Ingersoll" Oiler



The "New Ingersoll" Oiler

the "Reservoir" Oiler is advised.

This is of malleable iron and closely resembles the "New Ingersoll" throttle. The taper plug has a cup on one side. When the handle is turned up, this cup can be filled with oil through the opening. Turning the handle down empties this oil into the supply pipe, whence it is carried into the drill in a spray, without loss of pressure. The throttle and oiler are usually coupled up on a T-connection, as shown. The use of

The "Heart Beat" Oiler

The "Heart Beat" Oiler takes the responsibility for proper drill lubrication out of the hands of the runner and places it entirely in those of the superintendent or management. It operates by the pulsations of air in the supply pipe near the drill, due to the alternating reversals of the drill piston. It consists of

ROCK DRILL MOUNTINGS AND ACCESSORIES

an oiler body containing a plug carrying a cartridge of wire gauze and an absorbent material. The body is screwed into a tee, to the branch of which the drill is connected, the oiler coming above the tee and the throttle.

The cartridges are carried in boxes. Three cartridges will suffice for one shift. The drill runner going on shift takes three saturated cartridges from the superintendent or other party in charge. Coming off shift, he returns three dry cartridges, which are simply dropped in a tub of oil and re-charged. There is no way of drying the cartridges except by using them in the drill and the return of dry cartridges is proof that the drill has been properly oiled. The great saving of lubricant which this oiler effects is evident. The oil is not wasted—blown out without doing useful work—but is fed slowly, as needed, and used to best effect. The "Heart Beat" Oiler will quickly pay for itself in the cost of oil it saves.

The "Heart Beat" Oiler not only enforces proper lubrication of the drill, thus reducing its wear and increasing its capacity, but also economizes lubricant and prevents excessive discharge of oil over ores, the treatment of which may be seriously interfered with by too much oil.



The "Heart Beat" Oiler

Rock Drill Oilers

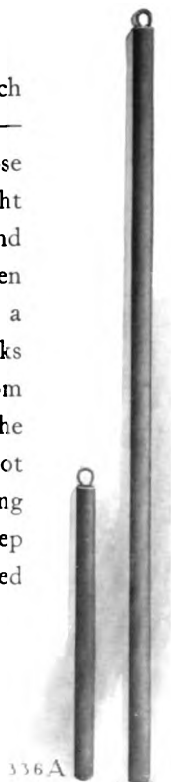
Type	Size	Price	Telegraph Name
"New Ingersoll".....	$\frac{3}{4}$ "	\$3.00	Leccolli
"New Ingersoll".....	1"	3.50	Lecconcino
"Reservoir".....	$\frac{3}{4}$ "	4.50	Leconessa
"Reservoir".....	1"	5.00	Leccornia
"Heart Beat".....	*	6.00	Leccume

*Furnished in only one size; if symbol of drill for which oiler is intended is given, suitable reducing tee can be furnished without extra cost.

ROCK DRILL MOUNTINGS AND ACCESSORIES

Sand Pumps

"Down" holes in rock forming a mud which will not splash out must be cleaned at intervals—usually at every change of steels. For this purpose the sand pump is used. It is a section of wrought iron boiler tube having a valve at its lower end which opens to admit the slush, but closes when the tube is lifted. At the upper end of the tube a chain should be attached, made up of several links of rod by which the pump is forced to the bottom of the hole. A ring at the last link prevents the chain from dropping in the hole. The two-foot length is used for cleaning holes without moving the drill; greater lengths are intended for deep holes. Standard sizes and prices are tabulated below.



Sand Pump with Bail

Sand Pumps

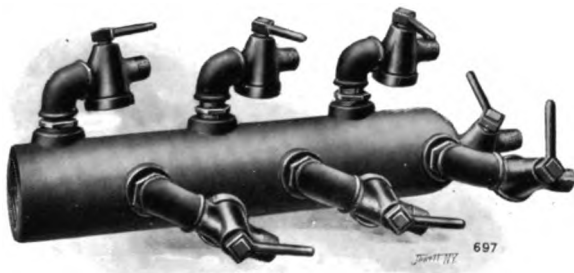
Inside Diameter.... Outside Diameter....		No. 1 ¾-inch 1⅞-inch	No. 2 1-inch 1⅞-inch	No. 3 1¼-inch 1⅞-inch	No. 4 1½-inch 1⅞-inch	No. 5 2-inch 2⅞-inch
Standard Sizes	Length	Tel. Name and Price	Tel. Name and Price	Tel. Name and Price	Tel. Name and Price	Tel. Name and Price
In Stock	2'	Laubdaches \$1.00	Laubfalles \$1.00	Laubfleck \$1.25	Laubgang \$1.50	Laubhain \$2.50
In Stock	4'	Lauberhuhn \$1.50	Laubfink \$1.50	Laubfrosch \$1.75	Laubganges \$2.00	Laubhainen \$3.00
To Order	6'	Laubfall \$2.00	Laubfinken \$2.00	Laubfutter \$2.25	Laubgruen \$2.50	Laubholz \$3.50
For each additional foot of length, add	...	25 cents	25 cents	25 cents	30 cents	30 cents

NOTE—Above prices are for pump complete with valve and bail, but do not include a chain or rod.

ROCK DRILL MOUNTINGS AND ACCESSORIES

Manifold or Header

Where a number of machines supplied from one pipe line are operated within a limited area, as in mines, tunnel headings and in some kinds of quarry and open cut work, the manifold is used for connecting individual hose lines to the main supply. It is an extra heavy malleable casting with branch openings in strong bosses on the main casting, each furnished with a bushing, nipple,



A Seven-Branch Manifold

elbow and throttle valve of proper size, ready to couple up to the hose. Two extra holes in the end are ordinarily closed with screw plugs. The manifold is made with branch openings as indicated in the table below. The supply opening may be bushed for any size of pipe.

Manifolds or Headers

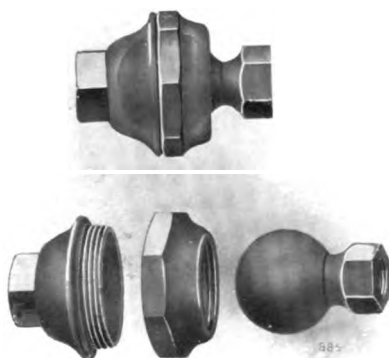
Number of Drills for which intended	W'gt Lbs.	Manifold with $\frac{3}{4}$ -inch Throttles (New Ingersoll)		Manifold with 1-inch Throttles (New Ingersoll)		Manifold with $1\frac{1}{4}$ -inch Throttles (New Ingersoll)	
		Price	Telegraph Name	Price	Telegraph Name	Price	Telegraph Name
4	47	\$28.00	Lechuguero	\$30.00	Lechzender	\$40.00	Leckerwerk
6	55	34.00	Lechuzas	37.00	Lechzest	52.00	Leckerzahn
7	60	37.00	Lechuzo	40.50	Leciseno	58.00	Lecksaft
10	100	*	Lechzen	*	Leckermaul	*	Leckstone

Number of Drills for which intended	Weight Pounds	Manifold with $\frac{3}{4}$ -inch Throttles (Old Style)		Manifold with 1-inch Throttles (Old Style)	
		Price	Telegraph Name	Price	Telegraph Name
4	44	\$23.00	Lecktasche	\$24.00	Lecoplaque
6	51	26.50	Leckwasser	28.00	Lecosperme
7	54	28.25	Leckwein	30.00	Lectabunt
10	93	*	Lecontite	*	Lectaremus

*Prices furnished on application.

Moran Flexible Pipe Joint

This is a ball-and-socket joint for quarry or open cut work where temporary pipe lines distribute the air or steam. Its great value is in giving flexibility over an irregular surface, especially where blasting or hoisting is going on. The angular movement is about 45° in any direction. Strong, compact, light and readily adjustable, it stands rough usage well and is the only satisfactory joint where flexibility under high pressure is essential. It entirely obviates the difficulties invariably arising with solid pipe joints in rock excavation. The Moran joint is designed to stand all ordinary pressures and is furnished tapped to the standard pipe threads indicated in the table below, which also lists the sizes and prices.



Moran Flexible Joint

NOTE—Lubrication of these joints must be provided where steam is used or where water is otherwise present; and this is most readily done by means of a small sight-feed lubricator placed on the pipe line near the boiler. But this scheme must never be used where the pipe line ends in hose, as the oil will work through and ruin the rubber tubing, unless the hose is specially prepared to resist it.

Moran Flexible Pipe Joint

Size of Pipe American Standard	Price	Telegraph Name	Size of Pipe American Standard	Price	Telegraph Name
1/2"	\$3.25	Lectarios	2"	\$7.50	Lecticaire
3/4"	3.75	Lectaturam	2 1/2"	9.00	Lecticole
1 1/4"	4.25	Lectaturis	3"	11.25	Lecticulis
1 1/4"	5.25	Lectaverim	4"	15.00	Lectiary
1 1/2"	6.00	Lecteurs	6"	25.00	Lectiary

ROCK DRILL BITS

Reproduced from the *Mining and Scientific Press*

By T. H. PROSKE

The success of almost every drilling operation depends on the selection and treatment of the bits. Too much attention cannot be given this important part of the work. If the bits have been properly formed, sharpened, and tempered for the work, and if they are changed just as soon as their edges and gauges are worn, the result will be found to be most economical. The power-drill sharpener has removed many of the shortcomings attendant upon the hand-sharpening process, with the result that where these machines are used it is possible to accomplish from 25 to 100% more drilling than under the old methods. The reasons for this are that the power sharpener turns out a much better bit. The saving in the blacksmith's wages should be a secondary consideration. The superior quality of the bits made in a machine will increase the capacity of the drilling machines sufficient to pay handsome dividends on the cost of the power sharpener.

For the guidance of those unfamiliar with the forms of drill-bits used in the different sections, I have prepared a few drawings of those in use. Fig. 1 represents the square cross-bit adopted as the standard for American mining practice. It is made from either round, octagon, or cruciform steel. In the copper mines of Michigan, it is usually made of a round steel. In the iron mines of Michigan and Minnesota and wherever this form of bit is used east of the Rocky Mountains, octagon steel is preferred, but in the Rocky Mountain and Pacific States cruciform steel is used. The reason for the adoption of this form of bit as a standard will be appreciated when the three requirements of a rock-drill bit are recalled. These are 'to chisel out a hole in the rock,' 'to keep this hole round and free from rifles,' and 'to mud freely.' There is really a fourth requirement, which is 'to do as much drilling as possible before being re-sharpened.'

The different kinds of rock to be drilled affect the wear of the bit. Very hard rock will blunt the chisel and reaming edges. The softer rocks do not blunt these edges, but wear the outer sides so that it loses its gauge and size, still appearing to be quite sharp. For this reason a bit that is made with a square edge and

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a clearance angle of 8° will drill about four times as long in soft rock as a bit with round edges and a clearance angle of 16° , before being reduced to the size of the next bit that is to follow. Referring to Fig. 1 and Fig. 2, the latter being a round-edge bit with a clearance angle of 16° , it will be seen that in Fig. 1 the corners of the bit at the base of the bevel describe a circle that is equal to the circle that the chisel edges describe. This is as it should be, as it is impossible for the chisel edge to cut out all of the rock. The reaming edge, which is that part of the bit extending from the chisel edge to the base of the bevel, marked 'A' in both Fig. 1 and

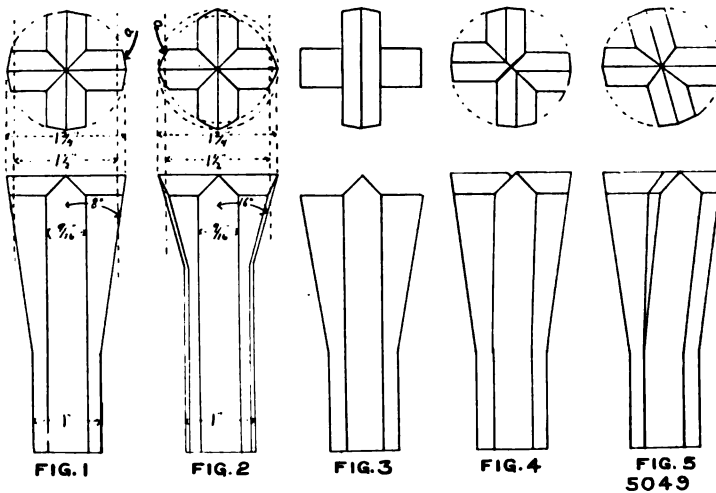


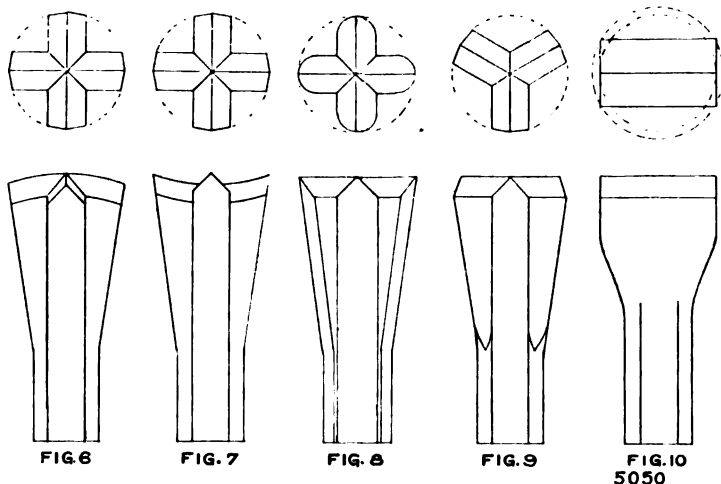
Fig. 2, must ream the outer edge of the hole and keep it round and free from rifles. In Fig. 2 it will be noted that the circle described by the corners of the bit at the base of the bevel is much smaller than the circle described by the chisel edges. This causes an excess of wear on the corners of the chisel edges, the bit rapidly loses its gauge, as well as its efficiency, and it is almost impossible to keep the hole round. Rifles form, and these cause the rotation parts of the drilling machine to break, often resulting in the loss of the hole.

The angle of the bevel of the face of the bit has to do with its

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life as well as with the property of 'mudding' freely. It is generally accepted that if this angle be 90° it gives strength and permits the bit to 'mud' or throw back the cuttings from the face of the bit when the drill is pointed downward. Bits made like Fig. 19 and Fig. 20 will not 'mud' freely. Another reason why bits such as is shown in Fig. 1 are preferable to those illustrated by Fig. 2, is that having a long wing they are stronger and will not break so readily as does a short bit.

The Simmons bit, used at the Champion mine at Beacon, Michigan, is shown in Fig. 3. In it two of the wings are devoted

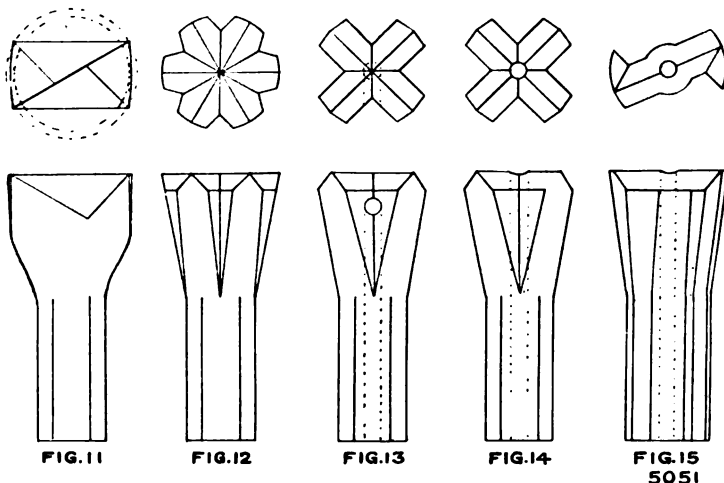


entirely to reaming and keeping the hole round and free from rifles. Some tests made several years ago in jasper, the hardest rock found in the Champion mine, using a $2\frac{3}{4}$ -in. Rand drill with 60-lb. air pressure at the compressor, showed an average speed per minute of 0.28 in. for the ordinary cross-bit, and 0.659 in. for the Simmons bit. Both forms were hand-sharpened.

The Brunton bit, the invention of the well known mining engineer, D. W. Brunton, is extensively used in Idaho and Montana. It is shown in Fig. 4. The object of this bit is to obtain the advantages of the X-bit without the attendant difficulties of re-sharpening. With this bit, as in the case of the X-bit, the

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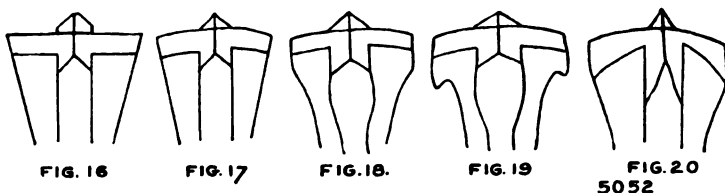
piston must revolve a half turn before the cutting edges will strike in the same place a second time. It is as easily re-sharpened as the regular square cross-bit. The X-bit itself is shown in Fig. 5. Since the invention of power-drill sharpening machines, this bit is fast disappearing. The reason will be understood when a comparison is made with the regular square cross-bit, as made with the power-sharpener, and the cross-bits as they are re-sharpened by hand, shown in Fig. 18, Fig. 19, and Fig. 20. The X-bit is designed to prevent rifles. This the hand-sharpened cross-bit would not do, but the machine-sharpened cross-bit



effectually accomplishes. Fig. 6 shows what is commonly termed the high-centre bit. This was for many years accepted as the proper form. It is still used in the mines of Cornwall and where Cornish customs prevail. Since the introduction of hammer-drills this bit is again finding favor. It is of especial advantage in starting a hole, the high centre immediately making an impression on the rock, whereas the square-faced bit requires a flat face for ready starting. For a starting bit in hammer machines it has no equal. Here, however, its advantages over the square bit end. Used as a bit to follow the starter, it is liable to follow slips and seams in the rock, causing crooked holes, which

are sometimes lost before being finished. This the square bit will not do. Fig. 7 shows a bit where the corners are in advance of the centre. This is a fast cutting bit. The corners break up the rock in advance of the centre and leave little for the centre to do; this causes the corners to wear fast, but still not to excess when it is considered that they do most of the work. This drill will not follow slips and seams, will drill a round hole, and is easy on the drilling machine. The weak point of this form is that the leverage is so great on the corners that they are liable to break off if tempered too hard. Fig. 8 shows the round-edge bit, which is a favorite with some. In soft rock this is good, but in hard rock it permits rifles to form in the hole because there are no reaming edges.

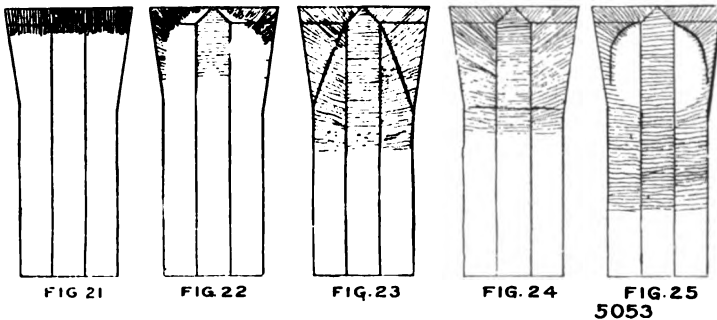
The Y-bit shown in Fig. 9 gives the advantage of plenty of room for the cuttings to escape. It is however, quite difficult to



make and re-sharpen by hand. With the power-sharpener it can be made as easily as any other form. Fig. 10 shows the 'bull' bit in use in the lead and zinc mines of the Joplin, Missouri, district, before the introduction of the power-sharpener. The extreme hardness of the limestone and flint in the sheet-ground of that district, caused the ordinary cross-bit as made by hand to wear too fast. This dull bull-bit therefore had to be adopted. Drilling here was not a matter of cutting the rock, but of shattering it by impact. The power-sharpener has changed all this, and the American standard cross-bit as made in these machines is now used. As a result the capacity of the drills has been materially increased. In mines where hand-sharpening is still done the bull-bit is yet in use. Fig. 11 shows the Z-bit used in hand-sharpening in the southeast Missouri lead district. This bit is also used quite extensively in Germany. In both places, however,

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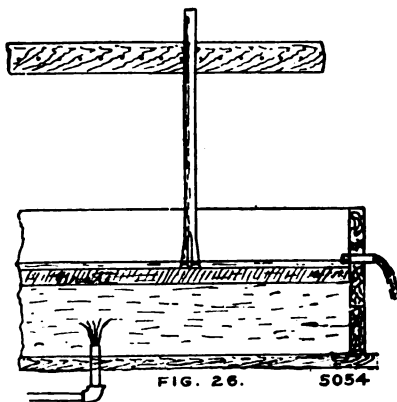
the advantage of the standard square cross-bit as made with the power-sharpener is fast causing it to be displaced. Fig. 12 shows the 'six-wing rosette' bit as made in the power-sharpener in use at the Penarroya mines of Spain. It is used in hammer drills only. Of all the rosette forms of bits this has been found to be the most satisfactory. Fig. 13 shows the square cross-bits when made up for hammer drills where a hole for the introduction of air or water to remove the cuttings apexes at a point back from the bevel of the bit in one of the recesses between the wings. Fig. 14 shows the same form where the hole ends in the centre of the cross of the cutting edges. This form of bit is extensively used. Its faults are that a core is formed by this hole; this core fills the hole, and causes a stoppage of air or water. These cores have



been known to become as much as 8 in. long, and are quite difficult to remove. To clear them away the core must be burned out by heating the steel the full length of the core in a slow fire; a sometimes slow and tedious process. This difficulty is entirely overcome by the use of the bit shown in Fig. 13. The Z-bit, Fig. 15, is extensively used in Germany. In hammer drilling machines, the steel is formed in bars having a Z shape. While I show this bar straight, it is usually twisted to form a spiral. It is an easy matter to form a Z-bit on the end of such a bar. The results obtained are excellent. Holes to a depth of 16 ft. horizontal have been drilled with this form of steel. The spiral draws out the cuttings much the same as an auger. Fig. 16 to Fig. 20 are given to show the evolution of the cross-bit where hand-sharpening is

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employed. There are two systems of hand-sharpening. One is known as the set-hammer system. In it the steel is hammered by placing a set-hammer on the bevels and driving the steel back. The results of this method are illustrated in Fig. 16 to Fig. 19. Fig. 16 shows a bit made by cutting the bevels with a chisel and is as it should be in form. Fig. 17 shows this bit after about the third sharpening. Fig. 18 is the same bit after about the sixth sharpening, and Fig. 19 is the same bit at about the time that the original cross that was formed on the bar of octagon steel has become exhausted. The other system of hand-sharpening is known as the fuller and dolly system. By this system the stock



is first drawn sharp at the corners as shown in Fig. 20 with the fuller, after which it should be set back in the centre with the dolly. Unfortunately the man swinging the sledge hammer gets tired before the bit is set back enough, the result is that the bit, partly finished, is left as shown in Fig. 20. It is because the power-sharpener has the staying power, and because it readily finishes a bit perfectly, that inferior bits like these are not to be found where machine sharpening is employed.

After a bit has been forged, it should be properly tempered as in Fig. 21. Fig. 22 shows the result of the common method of tempering. The centre of the bit is soft, while the corners are hard. When the bit is immersed in the water about an inch the

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large mass of metal in the centre cools more slowly than the corners since the corners have three sides exposed to the water. Perhaps the centre had not chilled at all when the bit is withdrawn for annealing, and the final result is a soft-centre bit, which will flatten and retard the work of drilling. Fig. 23 and Fig. 24 show the result of trying to temper the bit with the forging heat, by plunging the whole bit into the water as soon as it is sharpened. The line of tension induced by cooling is indicated. At this place the drill will break. Fig. 25 shows the checking caused by first chilling the steel back of the bit and then plunging with the forging heat.

For the purpose of tempering a bit as shown in Fig. 21 a tank should be provided, such as shown in section in Fig. 26. This should be about 12 in. deep by 12 wide, and of sufficient length to accommodate whatever number of drills are to be sharpened in a day with the machine. The water inlet should be at the bottom, and the outlet should be placed about $\frac{3}{4}$ in. above a grate which itself should be about 8 in. above the bottom. This permits the bit to be immersed to a depth of about $\frac{3}{4}$ in. With a tempering tank of this construction the bit can be hardened to any desired degree. This depends on the temperature of the bit when placed on the grate. It is essential that the drill stand in a vertical position. To lean either way would cause it to harden to a greater depth on one side than on the other, causing a tension that might lead to breaking of the wings. It is best to provide a rail around the tank about the distance required to hold the shortest drill, and to drive pins about 3 in. apart in this rail. By placing the drills between these pegs they can be kept in a vertical position. When using this tank a small flow sufficient to displace the water heated by the cooling of the bits should be turned on to keep the supply always cool.